L Number	Hits	Search Text	DB	Time stamp
1	4036450	data storage\$1	USPAT;	2004/06/11 13:23
			US-PGPUB;	200 1, 00, 11 20120
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			DERWENT;	
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2	16218	read adj write adj head\$!	USPAT;	2004/06/11 13:24
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			EPO; JPO;	
			DERWENT;	
			IBM_TDB	
3	7597355	media surface\$1	USPAT;	2004/06/11 13:24
	''	7	US-PGPUB;	2001/00/11 13.21
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			DERWENT;	
			IBM_TDB	
4	1153956	controller\$1	USPAT;	2004/06/11 13:25
'	1200500		US-PGPUB;	200 1/00/11 13:23
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			DERWENT;	
			IBM_TDB	
5	3459787	predetermined track density	USPAT;	2004/06/11 13:26
		,	US-PGPUB;	200 1, 00, 22 20120
			EPO; JPO;	
			DERWENT;	
1			IBM_TDB	
6	1953939	linear density	USPAT;	2004/06/11 13:26
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			DERWENT;	
			IBM_TDB	
7	2734127	error code level near1 data	USPAT;	2004/06/11 13:26
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			EPO; JPO;	
			DERWENT;	
			IBM_TDB	
8	13619	(data storage\$1) and (read adj write adj head\$!)	USPAT;	2004/06/11 13:27
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l			EPO; JPO;	
			DERWENT;	
			IBM_TDB	
9	15839	(media surface\$1) and ((data storage\$1) and (read adj write adj	USPAT;	2004/06/11 13:28
		head\$!))	US-PGPUB;	,
			EPO; JPO;	
[DERWENT;	
			IBM_TDB	
10	880	controller\$1 and ((media surface\$1) and ((data storage\$1) and	USPAT;	2004/06/11 13:28
		(read adj write adj head\$!)))	US-PGPUB;	
			EPO; JPO;	
			DERWENT;	
			IBM_TDB	
11	6004033	(predetermined track density) or (linear density) or (error code	USPAT;	2004/06/11 13:29
		level near1 data)	US-PGPUB;	
			EPO; JPO;	
			DERWENT;	
			IBM_TDB	
12	817	(controller\$1 and ((media surface\$1) and ((data storage\$1) and	USPAT;	2004/06/11 13:35
		(read adj write adj head\$!)))) and ((predetermined track density)	US-PGPUB;	
		or (linear density) or (error code level near1 data))	EPO; JPO;	
			DERWENT;	
			IBM_TDB	

13	2782885	maximum recordable track density	USPAT;	2004/06/11 13:36
			US-PGPUB;	
			EPO; JPO;	
			DERWENT;	
14	2965427	maximum recordable linear density	IBM_TDB USPAT;	2004/06/11 13:39
17	2903727	maximum recordable linear defisity	US-PGPUB;	2004/00/11 13:39
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			DERWENT;	
			IBM_TDB	
15	3326757	(maximum recordable track density) or (maximum recordable	USPAT;	2004/06/11 13:39
		linear density)	US-PGPUB;	
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			DERWENT;	
			IBM_TDB	
16	3944362	minimum recordable error code level near1 data	USPAT;	2004/06/11 13:40
			US-PGPUB;	
			EPO; JPO;	
			DERWENT;	
			IBM_TDB	
17	5991264	((maximum recordable track density) or (maximum recordable	USPAT;	2004/06/11 13:40
		linear density)) or (minimum recordable error code level near1	US-PGPUB;	
	1	data)	EPO; JPO;	
			DERWENT;	
18	749	((controller\$1 and ((modia curface\$1) and ((data damage\$1) and	IBM_TDB	2004/06/44 42:47
10	/49	((controller\$1 and ((media surface\$1) and ((data storage\$1) and	USPAT;	2004/06/11 13:47
		(read adj write adj head\$!)))) and ((predetermined track density)	US-PGPUB;	
		or (linear density) or (error code level near1 data))) and (((maximum recordable track density) or (maximum recordable	EPO; JPO; DERWENT;	
		linear density)) or (minimum recordable error code level near1		
		data))	IBM_TDB	
19	2554817	magnetic head	USPAT;	2004/06/11 13:47
	255 .52,	mugnette nedd	US-PGPUB;	200 1/00/11 15.47
			EPO; JPO;	
			DERWENT;	
			IBM_TDB	
20	7278716	magnetic surface	USPAT;	2004/06/11 13:47
			US-PGPUB;	
			EPO; JPO;	
	1		DERWENT;	
1	4070407	Anna markin han Nava I.A	IBM_TDB	
21	1873105	(magnetic head) and (magnetic surface)	USPAT;	2004/06/11 13:48
			US-PGPUB;	
			EPO; JPO;	
			DERWENT;	
22	210	(((controller\$1 and ((media surface\$1) and ((data storage\$1) and	IBM_TDB USPAT;	2004/06/11 12:51
	210	((controllers) and ((friedla surfaces)) and ((data storages)) and (read adj write adj head\$!)))) and ((predetermined track density)	US-PGPUB;	2004/06/11 13:51
		or (linear density) or (error code level near1 data))) and	EPO; JPO;	
		(((maximum recordable track density) or (maximum recordable	DERWENT;	
		linear density)) or (minimum recordable error code level near1	IBM_TDB	
		data))) and ((magnetic head) and (magnetic surface))		
23	364382	compar\$3 and (quality metric with reference metric)	USPAT;	2004/06/11 13:54
		•	US-PGPUB;	
			EPO; JPO;	
			DERWENT;	
34		 	IBM_TDB	
24	75	((((USPAT;	2004/06/11 13:56
		(read adj write adj head\$!)))) and ((predetermined track density)	US-PGPUB;	
		or (linear density) or (error code level near1 data))) and	EPO; JPO;	
		(((maximum recordable track density) or (maximum recordable	DERWENT;	
		linear density)) or (minimum recordable error code level near1 data))) and ((magnetic head) and (magnetic surface))) and	IBM_TDB	
		(compar\$3 and (quality metric with reference metric))		
·	1	(compares and (quality metric with reference metric))		l

- T-	2050103		LICOAT	2004/06/44 45 =5
25	2859107	acceptable error rate\$1	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/06/11 13:56
26	70	(((((controller\$1 and ((media surface\$1) and ((data storage\$1) and (read adj write adj head\$!)))) and ((predetermined track density) or (linear density) or (error code level near1 data))) and (((maximum recordable track density) or (maximum recordable linear density)) or (minimum recordable error code level near1 data))) and ((magnetic head) and (magnetic surface))) and (compar\$3 and (quality metric with reference metric))) and (acceptable error rate\$1)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/06/11 13:56
27	324749	measur\$3 with (((predetermined track density) or (linear density) or (error code level near1 data)))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/06/11 13:59
28	15	((((((controller\$1 and ((media surface\$1) and ((data storage\$1) and (read adj write adj head\$!)))) and ((predetermined track density) or (linear density) or (error code level near1 data))) and (((maximum recordable track density) or (maximum recordable linear density)) or (minimum recordable error code level near1 data))) and ((magnetic head) and (magnetic surface))) and (compar\$3 and (quality metric with reference metric))) and (acceptable error rate\$1)) and (measur\$3 with (((predetermined track density) or (linear density) or (error code level near1 data))))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/06/11 13:59
29	148307	program\$4 and (write data with (measur\$3 with (((predetermined track density) or (linear density) or (error code level near1 data)))))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/06/11 14:00
30	4	((((((((controller\$1 and ((media surface\$1) and ((data storage\$1) and (read adj write adj head\$!)))) and ((predetermined track density) or (linear density) or (error code level near1 data))) and (((maximum recordable track density) or (maximum recordable linear density)) or (minimum recordable error code level near1 data))) and ((magnetic head) and (magnetic surface))) and (compar\$3 and (quality metric with reference metric))) and (acceptable error rate\$1)) and (measur\$3 with (((predetermined track density) or (linear density) or (error code level near1 data)))))) and (program\$4 and (write data with (measur\$3 with (((predetermined track density) or (linear density) or (error code level near1 data))))))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/06/11 14:02
31	11356	714/774.ccls. or 714/?.ccls. or 360/?.ccls. or 369/?.ccls. or 365/?.ccls. or 386/?.ccls.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/06/11 14:04



(12) United States Patent Woodfill et al.

(10) Patent No.:

US 6,215,898 B1

(45) Date of Patent:

Apr. 10, 2001

(54) DATA PROCESSING SYSTEM AND METHOD

(75) Inventors: John Iselin Woodfill, San Francisco; Henry Harlyn Baker, Los Altos, both of CA (US); Brian Von Herzen,

Carson City, NV (US); Robert Dale Alkire, San Jose, CA (US)

(73) Assignee: Interval Research Corporation, Palo Alto, CA (US)

(*) Notice: Subject to any disclaimer, the term of this

patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: 08/839,767

(22) Filed: Apr. 15, 1997

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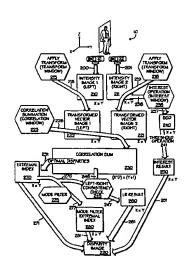
(List continued on next page.)

Primary Examiner—Scott Rogers (74) Attorney, Agent, or Firm—Ritter, VanPelt & Yi LLP

(57) ABSTRACT

A powerful, scaleable, and reconfigurable image processing system and method of processing data therein is described. This general purpose, reconfigurable engine with toroidal topology, distributed memory, and wide bandwidth I/O are capable of solving real applications at real-time speeds. The reconfigurable image processing system can be optimized to efficiently perform specialized computations, such as realtime video and audio processing. This reconfigurable image processing system provides high performance via high computational density, high memory bandwidth, and high I/O bandwidth. Generally, the reconfigurable image processing system and its control structure include a homogeneous array of 16 field programmable gate arrays (FPGA) and 16 static random access memories (SRAM) arranged in a partial torus configuration. The reconfigurable image processing system also includes a PCI bus interface chip, a clock control chip, and a datapath chip. It can be implemented in a single board. It receives data from its external environment, computes correspondence, and uses the results of the correspondence computations for various postprocessing industrial applications. The reconfigurable image processing system determines correspondence by using nonparametric local transforms followed by correlation. These non-parametric local transforms include the census and rank transforms. Other embodiments involve a combination of correspondence, rectification, a left-right consistency check, and the application of an interest operator.

40 Claims, 153 Drawing Sheets



L Number	Hits	Search Text	DB	Time stamp
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2	1258691	electrically writing data near1 unit adj unit	USPAT;	2004/06/11 19:30
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			DERWENT;	
			IBM_TDB	
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			DERWENT;	
			IBM_TDB	
4	1498489	nonvolatile memory	USPAT;	2004/06/11 19:31
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			IBM_TDB	
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	,	writing data near1 unit adj unit)) and (nonvolatile memory)	US-PGPUB;	
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			DERWENT;	
			IBM_TDB]
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			IBM_TDB	
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			IBM_TDB	
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			LI 0, 31 0,	
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11	112085	(electrically writing data near1 unit adj unit)) and (nonvolatile	DERWENT; IBM_TDB USPAT; US-PGPUB;	2004/06/11 19:38
11	112085	(electrically writing data near1 unit adj unit)) and (nonvolatile memory)) and (single semiconductor chip)) and (electrical	DERWENT; IBM_TDB USPAT; US-PGPUB; EPO; JPO;	2004/06/11 19:38
11	112085	(electrically writing data near1 unit adj unit)) and (nonvolatile	DERWENT; IBM_TDB USPAT; US-PGPUB; EPO; JPO; DERWENT;	2004/06/11 19:38
		(electrically writing data near1 unit adj unit)) and (nonvolatile memory)) and (single semiconductor chip)) and (electrical signal\$1)) and (signal process\$3)	DERWENT; IBM_TDB USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	
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11		(electrically writing data near1 unit adj unit)) and (nonvolatile memory)) and (single semiconductor chip)) and (electrical signal\$1)) and (signal process\$3)	DERWENT; IBM_TDB USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB USPAT; US-PGPUB;	
		(electrically writing data near1 unit adj unit)) and (nonvolatile memory)) and (single semiconductor chip)) and (electrical signal\$1)) and (signal process\$3)	DERWENT; IBM_TDB USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB USPAT;	2004/06/11 19:38

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		(electrically writing data near1 unit adj unit)) and (nonvolatile	US-PGPUB;	
		memory)) and (single semiconductor chip)) and (electrical	EPO; JPO;	·
		signal\$1)) and (signal process\$3)) and (check\$3 and (data with	DERWENT;	
		error\$1 or reliability))	IBM_TDB	
14	2354290	rewrit\$3 data and erased block\$1	USPAT;	2004/06/11 19:43
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			DERWENT;	
			IBM_TDB	
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		memory)) and (single semiconductor chip)) and (electrical	EPO; JPO;	
		signal\$1)) and (signal process\$3)) and (check\$3 and (data with	DERWENT;	
		error\$1 or reliability))) and (rewrit\$3 data and erased block\$1))	IBM_TDB	
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	1	signal\$1)) and (signal process\$3)) and (check\$3 and (data with	DERWENT;	
		error\$1 or reliability))) and (rewrit\$3 data and erased block\$1))	IBM_TDB	
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			DERWENT;	
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41		((((((((((((((((((((((((((((((((((((((USPAT;	2004/06/11 19:50
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		memory)) and (single semiconductor chip)) and (electrical	EPO; JPO;	
		signal\$1)) and (signal process\$3)) and (check\$3 and (data with	DERWENT;	
		error\$1 or reliability))) and (rewrit\$3 data and erased block\$1))	IBM_TDB	
		and (prescribed area)) and (microcomputer\$1 or (control		
	1	device\$1))) and (user data storage area)		l